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- CLAIMS -

1. A magnetic filtration system for filtering magnetisable material from a fluid in which said material is in suspension comprising inlet means and outlet means, in which a plurality of collection units (1) is disposed, each collection unit (1) comprising a plurality of plates (2, 3) or plate arrays disposed either side of one or a plurality of magnets (4) so that the plates (2, 3) or plate arrays have opposing polarities, wherein portions of the plates or plate arrays extend beyond part or all of an edge or edges of one or a plurality of said magnets (4), facing plates have one or a plurality of apertures, wherein facing apertures define a region of magnetic repulsion, and facing plate portions define therebetween, a region of magnetic attraction and magnetisable material collection, such that the magnetic flux fields thus created facilitate preferential collection of magnetisable materials in the collection region between facing portions rather than in the region between said facing apertures, and wherein facing collecting regions are disposed between facing apertures such that the attractive flux fields generated in the collection regions and the repulsive fields disposed either side thereof, facilitate collection in a volume sandwiched between exposed facing plate portions (2, 3), characterised in that the respective plates (2, 3) of adjacent collection units (1) having like polarity are disposed adjacent to one another so as to substantially restrict the collection of magnetisable particles to the collection regions substantially within the interior of the collection units.
2. A magnetic filtration system as in claim 1 characterised in that there is provided a housing (15) made of a non-magnetisable material, to thereby limit magnetisable material collection to the collecting regions within the collection units (1) if the collection units are disposed in close proximity to the interior of said housing (15).

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3. A magnetic filtration system as in claims 1 to 2 characterised in that there is provided a housing integral to a flow system, said filtration system still permitting fluid flow therethrough, even at contaminant capacity.
4. A magnetic filtration system as in claims 1 to 3 characterised in that each collection unit (1) is further separated from an adjacent collection unit (1) by a spacing member (9).
5. A magnetic filtration system as in claims 1 to 4 characterised in that the spacing member is non-magnetic.
6. A magnetic filtration system as in claims 1 to 5 characterised in that the spacing member is magnetic.
7. A magnetic filtration system as in claims 1 to 6 characterised in that the apertures (6) in respective collection units, which are in closer proximity to the inlet means, are larger than those of units disposed nearer the outlet means.
8. A magnetic filtration system as in claims 1 to 7 characterised in that alignment means is provided for disposing the apertures (6) and plate portions (5), in facing plates (2, 3) of a collection unit (1), in substantial axial alignment.
9. A magnetic filtration system as in claims 1 to 8 characterised in that further alignment means is provided for disposing the apertures, of respective collection units, in substantial axial alignment.
10. A magnetic filtration system as in claims 1 to 9 characterised in that said alignment means and further alignment means comprise a tab (11) of given dimension on an internal edge of the plate and an axial unit (8) having a groove (10) of corresponding dimension to that of the tab (11), into which groove said tab can locate to provide a chosen axial and radial alignment of the facing plate portions (5) and apertures (6) of a collection unit (1) and/or those of an assembly of collection units.

11. A magnetic filtration system as in claims 1 to 10 characterised in that the magnetic filtration system is further provided with flow directing means (14) for directing fluid flow from the inlet means towards the apertures (6) in said plates (2, 3).
12. A magnetic filtration system as in claims 1 to 11 characterised in that slot-like apertures (7) are provided in said apertures (6) and facing plate portions (5) to further enhance the magnetic flux density between the facing plates of each collection unit.
13. A magnetic filtration system as in claims 1 to 12 characterised in that facing pole piece pairs (5) are curved towards one another to further enhance the magnetic flux fields therebetween.
- 10 14. A magnetic filtration system as in claims 1 to 13 characterised in that facing plate/ plate array pairs (5) are separated by a distance which best utilises the magnetic flux emergent from the edges of said facing plates/ plate arrays to attract and retain magnetisable material in the fluid and which also facilitates a required collection capacity.
- 15 15. A magnetic filtration system as in claims 1 to 14 characterised in that the attractive flux lines between facing plate portions (5) are substantially orthogonal to the repulsive flux lines in the apertures (6), such that magnetisable material entering the apertures, is subject to the influence of both attractive and repulsive flux fields.
16. A magnetic filtration system as in claims 1 to 15 characterised in that internal surfaces of the housing are disposed in close proximity to the outer portions of the plate/ plate array pairs in order to substantially constrain fluid flow in the filtration system to regions in which magnetic flux fields generated by facing plate/ plate array pairs facilitate the attraction and retention of the size range and type or types of non-magnetisable particle input to the filtration system, for example, ferrous particles smaller than one micron.
- 20 17. A magnetic filtration system as in claims 1 to 16 characterised in that one or a plurality of distribution plates (12) have further apertures in substantial axial alignment with said
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plate apertures, which can be disposed either side of one or more of the collection units (1) to ensure that all fluid is exposed to regions having magnetic flux density, similar to, or greater than a threshold required for particle attraction.

18. A magnetic filtration system as in claims 1 to 17 characterised in that the housing (15) comprises one or a plurality of sealable sections with interlockable threaded portions that enable said sections to be readily assembled or dismantled.

19. A magnetic filtration system as in claims 1 to 18 characterised in that the housing (15) is further provided with means for attachment to a fluid system.

20. A magnetic filtration system as in claims 1 to 19 characterised in that isolation means may be provided for isolating fluid flow to and from the filtration system to facilitate its removal from and insertion into the fluid system.

21. A magnetic filtration system as in claims 1 to 20 characterised in that monitoring means for monitoring the presence and/or amount of material collected is disposed in the filtration system, so that particle collection and therefore wear can be assessed without dismantling the system.

22. A magnetic filtration system as in claims 1 to 21 characterised in that close down means is provided for enabling a system, of which said filtration system is a part, to be closed down if a pre-determined level of debris collected is reached.

23. A magnetic filtration system as in claims 1 to 22 characterised in that conventional filter media (90) is disposed in the housing to remove non-magnetisable particles input to the system.

24. A magnetic filtration system as in claims 1 to 23 characterised in that the magnet or magnets in the collection unit(s) is/ are electromagnet(s) (80) having switch means for activating the electromagnet(s) to collect particles and for de-activating the electromagnet(s) to facilitate release of any particles collected.

25. A magnetic filtration system as in claims 1 to 24 characterised in that conventional cellulose fibre, metal or other filter material is included in the magnetic filtration system to remove non-magnetisable material input to said system.
26. A magnetic filtration system as in claims 1 to 25 characterised in that said conventional
5 filter material is placed downstream of one or a plurality of collection units.
27. A method for removing magnetisable particles from a fluid system in which said particles are in suspension characterised in that the steps include providing an apparatus as claimed in Claim 1, passing fluid through said regions of magnetic repulsion, attracting and retaining said particles in said regions of magnetic attraction and repelling particles
10 from said apertures and from between adjacent collection units to thereby further enhance magnetic flux lines within the collection units, even in conditions of high fluid flow and turbulence.
28. A method as claimed in claim 27 characterised in that the method includes the steps of
15 detaching the plates from the magnets and mechanical removal of debris from the plates and the magnets.
29. A method as claimed in claim 27 characterised in that the method includes the step of blowing off particles collected, in an undismantled collection unit assembly, with an air line.
30. A method as claimed in claim 27 characterised in that the steps include providing an
20 apparatus as claimed in Claim 24, passing fluid through said apertures, activating the electromagnet to retain said particles in said regions of magnetic attraction and repel particles from said apertures, de-activating the electromagnet to release the particles from said regions of magnetic attraction and disposing of said particles from said fluid system.

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31. A method as claimed in claim 30 characterised in that the method for activating and de-activating the electromagnet includes the step of passing current through coils of the electromagnet.

32. A method for monitoring the quantity and/ or type of debris collected includes the steps
- 5 of providing the apparatus as claimed in Claim 1 or Claim 24, providing detection means for detecting the presence of particles collected between facing plate portions, part of which detection means extends in the collecting region of one or more collection units, monitoring the type or quantity of material present, providing alarm means, setting off the alarm if material quantity rises beyond a pre-determined rate or amount, providing closing
- 10 down means for the fluid system and closing down the fluid system if the quantity of material rises beyond a further pre-determined rate or amount.

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